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AUTHOR Magidson, Errol
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ABSTRACT

The objective of this practicum was to apply mastery learning principles in the development of a computer-based instruction lesson on "Divisibility Rules," which was designed for students preparing for the General Education Development (GED) examination. This practicum sought to demonstrate that computer-based instruction which follows mastery learning principles facilitates student learning and fosters positive student attitudes toward learning. The lesson on "Divisibility Rules" follows a systematic approach to instruction that offers the student a rationale, objectives, pretest, alternative learning activities, and posttest with provision for revision. PLATO (Programmed Logic for Automatic Teaching Operations) is a computer-oriented instructional system that allows instructors to design individualized lessons for their students. The achievement results of the target group failed to measure up to the goal that 80 percent would achieve mastery. Technical difficulties hampered the results. The attitudinal results, however, were unanimously positive; this demonstrates that mastery learning strategies can provide students with enjoyable learning experiences. (MJK)

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# MASTERY LEARNING AND PLATO

## LEARNING THEORY AND APPLICATIONS

by

Errol Magidson, M.A.T.
Kennedy-King College

A PRACTICUM PRESENTED TO NOVA UNIVERSITY
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# MASTERY LEARNING AND PLATO

## I. Introduction

> Sometimes it seems as though, in spite of all the discoveries made by psychologists in the past two generations that have application to the processes of education, in too many places education is still coasting along on traditional rule-of-thumb methods.[1]

Percival Symonds wrote this in 1964, and it is still an appropriate judgment a decade later. So much of what goes on in the classroom has not had the benefit of proven learning principles. Many good teachers continue to use methods which may be comfortable to them rather than helpful to their students' learning. Poor teachers do not take any learning principles into account and usually spend most of their class time "lecturing at" students rather than involving them in the learning process.

There is also growing evidence that a "student's inability to meet the school's learning requirements tends to cause the development of a negative self-concept in minimally the academic area"[2] and that there is a positive correlation between repeated academic failure and a student's inability to adjust socially.

Two innovative contributions to education may indeed

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provide the breakthrough necessary to establish more thorough and enjoyable learning experiences for students. These contributions are the application of the concept of "mastery learning"[3] and the use of PLATO,[4] the sophisticated computer-based education system.

This practicum seeks to demonstrate that computer-based instruction which follows mastery learning principles will facilitate student learning and foster positive student attitudes towards learning.

## II. Background and Significance

### Mastery Learning: Definition

Mastery learning advocates propose that nearly all students can master the instruction they receive. In most conventional learning situations about one-fourth of the students achieve at high levels, but under mastery learning more than three-fourths of the students can achieve at the same high levels. Students can achieve more in less time under mastery learning, and such achievement increases student interest in the subject and positively influences their attitudes towards the subject. Let us operationally define mastery learning as a learning system which ensures that 80 percent of a class of students will achieve at least "B" level work or better.

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Development of Mastery Learning

Carleton Washburne's Winnetka Plan and Henry Morrison's approach at the Laboratory School of the University of Chicago applied the concept of mastery learning for the first time in a major way during the 1920's. These programs were unique in that they defined mastery learning in terms of behavioral objectives that each student was to attain. Washburne in 1922 used cognitive objectives, and Morrison in 1926 used cognitive, affective and psychomotor objectives. They divided subject matter into well-defined learning units. The Winnetka Plan designed skills in hierarchical fashion with the simpler ones coming first and then building on these. Students were expected to master the skills of each unit before allowed to go on to the next. At the completion of each unit was an ungraded test which was used to determine whether the student had mastered the instruction and to provide diagnostic feedback on the student's progress. Thus, the student was rewarded with the knowledge that he had successfully mastered the material he was learning, or he was given further instruction on the material he still was required to master. Washburne's Winnetka Plan relied primarily on self-instructional material. Morrison used tutoring, revising instructional techniques, and helping the student improve his study habits. In both programs, learning was primarily self-paced. Under Washburne, the

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student was allowed all the time he needed to progress until he achieved mastery. Under Morrison, the teacher was responsible for bringing most of the students to mastery level.

Mastery learning faded into disuse until the 1960's largely because the necessary technology was not there to support such a strategy.[5] It gained popularity because of the rise to prominence of programmed instruction. B. F. Skinner's article on "Teaching Machines," published in Scientific American in November 1961, proposed three principles which were to serve as an adjunct to mastery learning. The first was that the learner must be involved with what he is learning; according to Skinner, "There is a constant exchange between program and student." The second principle was that a student will learn whatever he responds; thus good instruction supposedly demands a design that will ensure minimal error. The third was that the student must be provided with "knowledge of results," which is especially important when he does make a mistake.[6]

The kind of programmed instruction identified by Skinner lost favor in the late 1960's for two reasons. First, many students did not profit by the tedious experience offered by the small-step learning and bland language of the instruction. Second, the rise of third generation computers during the 1960's gave programmed instruction the necessary sophistication to be more flexible in assisting

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the instructional process.

A useful mastery learning model was developed by John B. Carroll in his "Model of School Learning" in 1963.[7] Carroll looked at "aptitude" not as an index of the level to which a student could learn, but rather as an index measuring the amount of time it took a student to learn a given amount of material (task) to a given criterion level under perfect instructional conditions. That is, if a student were allowed enough time to learn a task, he could master it, or the degree of learning is a function of the time actually spent by the student divided by the time he actually needed. Under this model, the student progressed from knowing nothing about performing a task or understanding a concept to performing it. The degree of learning under Carroll's model involved the time the learner was allowed to learn the material together with his "perseverance" in learning it; the major constraints included his aptitude, the quality of instruction and his ability to understand the instruction.[8]

It was Benjamin S. Bloom who provided an effective working model of mastery learning. Bloom contended that aptitude and achievement were indeed positively correlated when the class was normally distributed in terms of aptitude and when the instruction was conventional; however, if the students were normally distributed on aptitude but each were given as much time as he needed to

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learn what may be regarded as the highest quality of instruction, then the learning curve would be skewed towards achievement.[9]

In his strategy for implementing these ideas, Bloom accepted the idea that the time allowed for learning would be somewhat fixed. Mastery was defined in terms of the behavioral objectives each student was to demonstrate at the subject's completion. The subject-matter was decomposed into small learning units which involved about two weeks of instruction. It was the instructor's responsibility to teach each unit to the class and to provide supplementary material for each student to ensure that the instruction was of optimal quality. The design of the instructional content was meticulously worked out so that each element was taught in special sequence and structure with provision for appropriate diagnostic feedback to the student and to the instructor for formative evaluation. Every effort was made to have each student actively involved in the learning process; and a variety of learning techniques were provided, including small-group sessions, individualized tutoring, programmed instruction, workbooks, audio-visual aids, game-playing and reteaching.[10]

It should be noted that research on mastery learning has shown that the quality of each student's instruction is the key factor reflecting individual achievement,

otherwise such initial factors as aptitude and previous learning predetermine achievement.[11]

Application of Mastery Learning

In a democratic society, one major goal of education should be to promote the development of the individual; yet education has traditionally impeded the growth of the individual by fostering a grading system which rewards only those students whose achievement places them in the upper third of their class. Under mastery learning, the goal is to bring nearly all the students in a class into the top third category. This means that relatively slow learners must be given suitable learning activities that will reduce the amount of time they require to master a given topic. The key to this is optimizing instruction so that each task involved in learning a given topic is identified and ordered to meet the needs and characteristics of each learner. Such structuring of the tasks needed for mastery is dependent upon the ability of the learner to understand the task and the procedures he must follow to learn it.

To meet individual differences, the instructor should develop a set of alternative instructional materials which apply various learning techniques.[12] Small-group discussion sessions are useful when they foster cooperation rather than competition; tutorial assistance is very

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effective but expensive; workbooks and programmed texts are especially useful to those students who require more drill and practice; audio-visual aids may do a good job of presenting the whole picture; alternative reading materials may be used to provide a variety of ways to look at the same points. It is advisable that each student have some choice in deciding what supplementary aids to instruction might best suit his needs.

In order for mastery learning to work, each student must be assessed on his own performance, and this assessment should be frequent and with the kind of diagnostic feedback that will provide the student with prescriptive help to overcome his difficulties. Essentially, these frequent assessments are made on the basis of formative tests which are ungraded. Final, or summative tests should be given ideally when the instructor and student feel the student is ready for such tests. The instructor should be constantly reviewing his instruction and the supplementary materials he uses in order to make revisions and possibly corrections. The results on the formative tests should provide a clue to which tasks need modification in their presentation.

The positive outcomes of mastery learning are heartening both to the student and to the instructor. Not only does cognitive learning take place, but student motivation increases and an overall feeling of being able to control ideas and skills takes place. These outcomes serve to

enhance further learning.[13]

## PLATO: Description

PLATO, an acronym for "programmed logic for automatic teaching operation," is the computer-assisted instructional system developed at the University of Illinois in Urbana;[14] it allows instructors to design individualized lessons for their students.

The standard PLATO IV student terminal consists of a TV-like screen which displays the instructional material, the student's responses, and PLATO's responses; a keyset which is similar to an ordinary typewriter but has extra special-function keys and which allows the student to enter responses, transmitting these to the central computer at the Urbana campus; and a slide selector by which the computer can randomly access up to 256 color slides in microfiche format.

PLATO is similar to other programmed-learning materials in that it allows each student to work at his own pace and in that it can give appropriate feedback based on the student's performance. Here the similarity ends, for PLATO is much more versatile; it can serve as text, test and tutor. The student who demonstrates he needs minimal instruction in one area can be directed to new and more difficult material, while the student who needs more assistance can be presented with as much detailed help and review as is deemed necessary. Because PLATO follows

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the rules set forth by the instructor who designs and programs the lesson, PLATO can be made to handle nearly every kind of student response.

PLATO can keep very precise and objective records of all student responses and make such data or a summary of such data available to the instructor. Because of its computational ability, PLATO can be made to give endless drills and practice according to the individual student's performance. PLATO is also particularly useful for handling tutorial material, games and simulations.

Because PLATO follows a highly flexible, yet relatively easy authoring language, some instructors are able to learn how to devise effective lessons, and those lessons are easily edited. Instead of having to use punch cards for programming, the author of a PLATO lesson types the programming language into the computer's memory bank through the same terminal that the student uses.[15]

Mastery Learning on PLATO

PLATO provides instructors a package which applies the various learning principles useful for achieving mastery. First, the student is actively involved in the learning process.[16] Second, lessons produced on PLATO can inform students of what is expected of them. Students know in advance what performance level they need to achieve for mastery; they do not need to compete against each other

to determine their achievement level in terms of relative ranking. Third and fourth, instruction is divided into short units in which diagnostic practice exercises are given to enhance repetitive learning and provide appropriate immediate feedback which pinpoints student errors. Fifth, on the basis of a student's performance, he can be given review or help or additional instruction. Sixth, Learning with understanding not only improves retention but also better qualifies the learner to advance to new learning.[17] In many cases, the student can decide if he wants help or review. Seventh, students can be given more or less time to finish a lesson depending more on how much time an individual student needs than on the time needed by the entire group.

Another factor in developing strategies for mastery learning is that the instructor is expected to do formative and summative evaluations on his instruction. This aspect is enhanced by PLATO in that PLATO lessons can be re-edited with relative ease. A survey conducted by the CERL evaluation team at the University of Illinois in Urbana reported in January 1972 that students were expressing more favorable attitudes by successive classes; this suggests that they were achieving higher scores on tests.[18]

Students' Evaluation of PLATO at a Community College

Mastery learning on PLATO could have its greatest impact

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on those students who have had a long history of failure in the classroom. It is accepted that the above-average achievers who attend a major university such as the University of Illinois should be able to adapt very quickly to an innovative instructional tool such as PLATO, but what about student acceptance of PLATO in the community colleges? Moreover, community college faculty have been accused of being overly conservative in their approach to instruction, while their students have shown the greatest need for innovative approaches to teaching and learning.

One community college, Kennedy-King College, has been having some of its students use the PLATO system since the fall of 1973. The College enrolls over 10,000 students, most of whom live in the Englewood area of Chicago, a poverty-stricken neighborhood on Chicago's South Side. The central administration of the City Colleges of Chicago prepared selected characteristics of Kennedy-King College students for the fall semester 1973 and are presented in part in Appendix A (see page 28).[19]

The composite Kennedy-King student is a black female over 21 who ranked in the lower portion of the second quarter of her high school graduating class. She lives four miles from the College, majors in business or social service, plans to attend a four-year college, and lives in a family that earns just over $7500 annually.

Statistics do not necessarily present a complete view of the average Kennedy-King student. The difficulties that beset inner-city residents, such as health problems, financial insecurity, inadequate housing and child care, and emotional problems complicate the efforts of the students to succeed academically.[20]

Reading skills among Kennedy-King students range from the second to the twelfth grade-level. Many students have difficulty in reading class assignments and in understanding the academic language used by the faculty.

To help ascertain how well PLATO was assisting students with their classwork, a Students PLATO Evaluation survey was conducted. A copy of this questionnaire is in Appendix B (see page 31).[21] Responsibility for the distribution and collection of the questionnaire was given to the eleven instructors who had been having their students use PLATO during the spring semester 1974 for at least four sessions. About 200 forms were distributed by the PLATO coordinator among eleven instructors representing six disciplines, including biology, chemistry, mathematics, English, GED and music. A total of 186 completed questionnaires were returned.

Selected data are included in Appendix C (see page 32).[22] Here are some of the important data which demonstrate how PLATO is positively affecting student attitudes towards education:

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1) 164 of 172 respondents (95.3%) felt they "often" or"sometimes" had "fun" using PLATO.

   54.7% responded "often."

   40.7% responded "sometimes."

2) 165 of 173 respondents (95.4%) felt that PLATO was "often" or "sometimes" "challenging."

   63.6% responded "often."

   31.8% responded "sometimes."

3) All 177 respondents felt that "most" or "some" of the PLATO lessons they had used taught them what the lessons were trying to teach.

   59.9% responded "most."

   40.1% responded "some."

4) 162 of 185 respondents (87.6%) felt that typing answers had bothered them either "not at all" or "very little."

   64.3% responded "not at all."

   23.2% responded "very little."

   10.8% responded "somewhat."

   1.6% responded "quite a lot."

5) Perhaps most important, 166 of 186 respondents (89.2%) indicated they would "encourage (their) friends to take a course that uses PLATO."

   89.2% responded "yes."

   2.7% responded "no."

   8.1% responded "uncertain."

Here are a few of the favorable comments taken from the survey in response to the question, "What have you liked most about PLATO?"

"The ability to help myself."

"It gives you everything you need to know about the subject step by step."

"I really liked PLATO a lot, because it helped me to understand the material in class better."

"I learn more on a one to one basis, and what I do with PLATO is between it and myself."

"The way it explains the answer and helps you whenever you get a wrong answer."

## III. Procedures

### Designing a Lesson Employing Mastery Learning Principles

This writer designed and programmed for the PLATO system a lesson on "Divisibility Rules." This lesson was designed to apply mastery learning principles by following a systematic approach to instruction as outlined by Barton Herrscher.[23]

The lesson contains a rationale to introduce the topic and explain its meaningfulness to the student; learning objectives to state what the expective outcomes of student behavior are (specific objectives including conditions and standards as well as activities are given during practice exercises rather than in a list to make them more understandable and meaningful); a pretest to determine if the student needs to complete the instruction; learning activities employing a variety of techniques and strategies; and a posttest to determine to what extent the student has achieved the learning objectives. If he does not demonstrate mastery, the student is recycled through the system (see figure 1, p. 16).

The concept of revision is a built-in feature.

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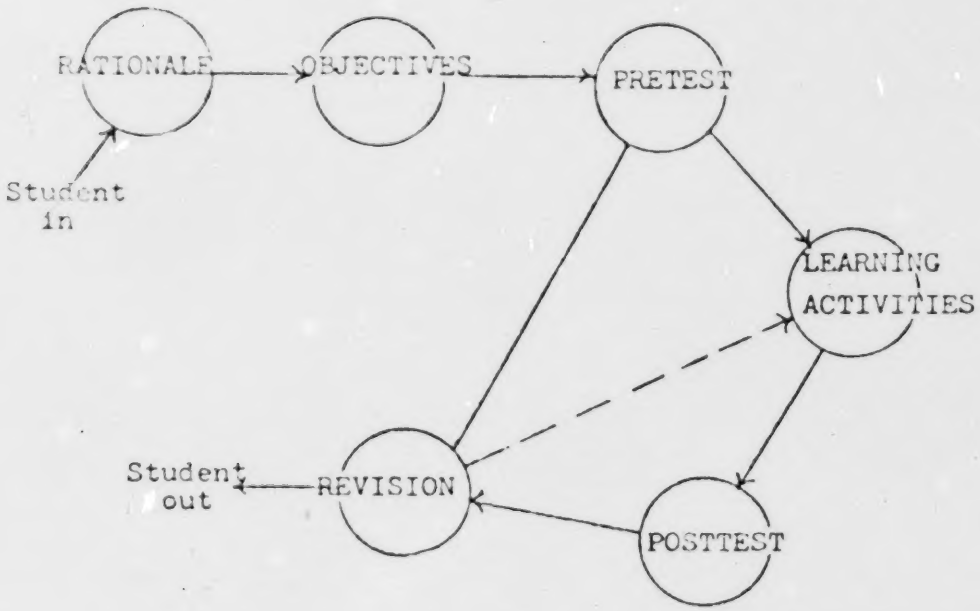
Records were kept on student performance to determine how each student proceeded through the instruction and how each performed. The lesson was developmentally tested by several instructors and students and subsequently revised on the basis of suggestions and performance data.

Fig. 1. A Learning System[24]




Lesson topics include separate sections on determining whether numbers are divisible by 2, by 3, by 5, and by 10; a test in which the student has to select one of these numbers or "n" for none of them to demonstrate that he

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can use any of these rules; a section on applying the rules for reducing fractions; and a final test in which the student must determine all the special divisors (2, 3, 5, 10 or "n" for none of these) that will reduce a fraction.

There is also an optional series of topics that can be used for enrichment or as part of the required instruction. The student can learn the divisibility rules for the numbers 4, 6 and 9; how to use the Euclidian method for finding the largest number that will reduce a fraction (greatest common divisor or GCD); and a section in which the student can type his own fraction, have it reduced by PLATO showing its GCD, and have PLATO show the step-by-step procedure for arriving at the GCD for his fraction.

This lesson applies the mastery learning principles outlined on pages 10 and 11. It can be accessed by any PLATO terminal under the lesson code "divr." A flowchart of this lesson is on page 18. Sample frames (pages) are offered in Appendix D (see page 36).

The lesson on "Divisibility Rules" was designed specifically for adult learners with at least a sixth-grade reading level. It could be used by college students in need of remedial work with fractions and by students preparing for the High School Equivalency examination (GED). GED students are adults over 21 who

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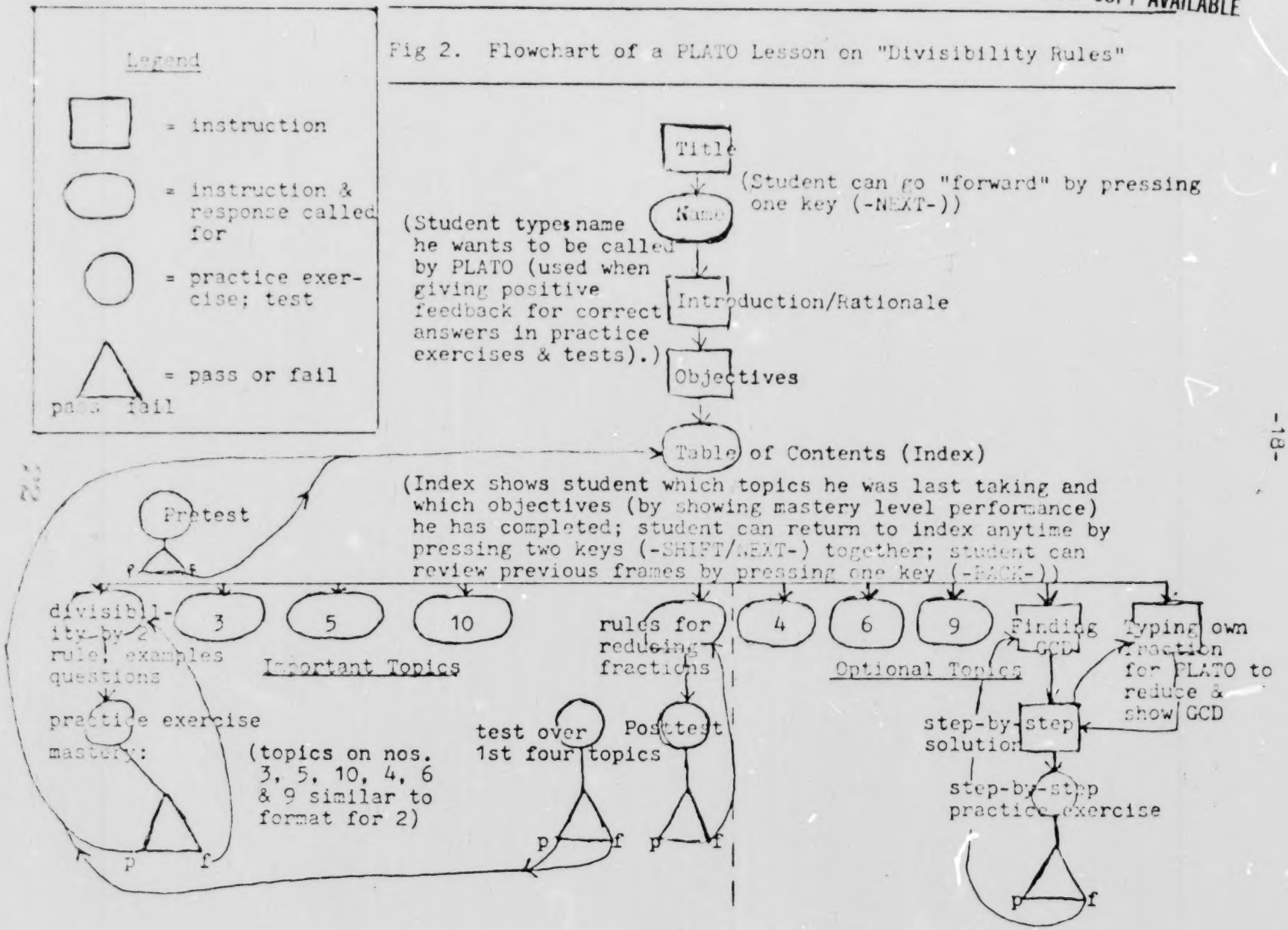
Fig 2. Flowchart of a PLATO Lesson on "Divisibility Rules"


Legend
= instruction
= instruction & response called for
= practice exercise; test
= pass or fail
pass fail
Title
Name
(Student types name he wants to be called by PLATO (used when giving positive feedback for correct answers in practice exercises & tests).)
(Student can go "forward" by pressing one key (-NEXT-))
Introduction/Rationale
Objectives
Table of Contents (Index)
(Index shows student which topics he was last taking and which objectives (by showing mastery level performance) he has completed; student can return to index anytime by pressing two keys (-SHIFT/NEXT-) together; student can review previous frames by pressing one key (-BACK-))
Pretest
p f
divisibility-by-2 rule; examples questions
practice exercise
mastery:
p f
3
5
10
Important Topics
(topics on nos. 3, 5, 10, 4, 6 & 9 similar to format for 2)
rules for reducing fractions
test over 1st four topics
p f
Posttest
p f
4
6
9
Optional Topics
Finding GCD
Typing own fraction for PLATO to reduce & show GCD
step-by-step solution
step-by-step practice exercise
p f

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did not complete high school. The instruction GED students receive should follow proven learning principles to foster success because these students usually perceive their time back in the classroom as a last-chance effort to complete high school by passing a difficult examination.

## Developmental Testing of "Divisibility Rules"

In order to determine the effectiveness of the lesson on "Divisibility Rules" before having the target group of GED students use it, the lesson was critically evaluated by two instructors, a staff assistant, a work-study student, and several other students. The instructors were mathematics instructors, one also being a PLATO author.

It is important to thoroughly test a lesson for errors in programming, content and technique. Programming errors can be frustrating to student users, and content errors are inexcusable.

The staff assistant and the work-study student were given a checklist on evaluating a PLATO lesson that was developed by this writer (see Appendix E, page 40).

Revisions of the lesson were made on the basis of suggestions from the instructors, the evaluation checklists that were submitted, and from observing a class of first-semester mathematics students proceed through the lesson.

Some of the more important suggestions for revision and subsequent changes include the following:

1) The language used in portions of the lesson needed more clarity.

2) The table of contents needed to give the student more direction: important topics were then arranged separate from optional topics, and the student received a message on PLATO that he should complete each topic in the order it was listed. Students who had been selecting topics at random had problems when they took the test; in many cases they were skipping topics and trying to take the test.

3) The student needed more time to complete each item on the practice exercises and tests (the student had been given too few seconds to complete each item): timed exercises were kept but lengthened to ensure that the student could apply the divisibility rules quickly and not attempt to solve each problem long-hand.

4) The number of items the student needed to answer correctly in each section to show mastery was reduced to provide enough time for a student to complete the lesson within one regular class period. Mastery level on the final examination was set at an achievement score of 10 correct while not missing more than 3 problems; as soon as a student missed 4 problems, he would be taken to the instruction.

5) Short-answer and multiple-choice questions in sections covering divisibility rules for certain numbers (2, 3, 5 and 10) were made more understandable by eliminating a format which included incorrect items together with correct ones.

Administration of the Lesson to GED Students

This writer discussed with a GED mathematics instructor having several students use a class period to interact with a PLATO lesson on "Divisibility Rules."

Since the students had not used PLATO before, it was decided that they be given a short demonstration of PLATO just before interacting with the lesson.

The lesson was to be evaluated on the basis of student

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performance on the pretest and posttest and on the basis of the students' attitudes towards PLATO and the lesson (see Appendix F, page 43).

IV. Results

The achievement scores of the fourteen students who participated in this experiment of designing a lesson to teach for mastery learning is listed below:

Fig. 3. Results of GED Students on a PLATO Lesson's Tests (November 1974)

| Student | Pretest Score Right | Wrong | % | Posttest Score Right | Wrong | % | Gain/loss Score |
|---|---|---|---|---|---|---|---|
| A | 0 | 4 | 0 | 7 | 4 | 63.64 | +7 |
| B | 2 | 4 | 33.33 | 10 | 0 | 100.00 | +8 |
| C | 7 | 4 | 63.64 | 10 | 0 | 100.00 | +3 |
| D | 4 | 4 | 50.00 | 10 | 3 | 76.92 | +6 |
| E | 2 | 4 | 33.33 | 10 | 1 | 90.91 | +8 |
| F | 0 | 4 | 0 | 3 | 4 | 42.86 | +3 |
| G | 7 | 4 | 63.64 | 10 | 0 | 100.00 | +3 |
| H | 3 | 4 | 42.86 | 9 | 4 | 69.23 | +6 |
| I | 2 | 4 | 33.33 | 5 | 4 | 55.55 | +3 |
| J | 1 | 4 | 20.00 | | | | |
| K | 1 | 4 | 20.00 | | | | |
| L | 0 | 4 | 0 | | | | |
| M | 2 | 4 | 0 | | | | |
| N | 0 | 4 | 0 | | | | |

These students did not have enough time to complete the posttest.

The hypothesis that a computer-based instruction lesson

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designed to apply mastery learning principles will enhance student achievement is not supported by these results primarily because not everyone was able to complete the lesson. Scheduling conflicts and absenteeism prevented these students from finishing. Also, these students had never used PLATO before and understandably had difficulty operating the machine. This lesson needs to be readministered.

Only five of nine students who took both the pretest and posttest showed mastery (76.92% or better scores). It should be noted that scores for all students would have been higher had some credit been given for partially correct answers. Mastery could also have been ensured by compelling students to provide only one divisor that would evenly divide the numerator and denominator of each fraction presented; instead, the students were required to name all of the most frequently used divisors (2, 3, 5 and 10 or none of these) in less than thirty seconds for each fraction.

The hypothesis that a computer-based instruction lesson designed to apply mastery learning principles will foster positive student attitudes towards learning was demonstrated by the results on the survey of student attitudes (see Appendix F, page 43). In spite of the difficulties these students had in operating PLATO for the first time, they were very favorably impressed by PLATO and the lesson.

On the question "Did you enjoy PLATO," 13 of 14 students checked the statement that it was "one of the most enjoyable educational experiences I have had;" one student checked the statement that it was "quite enjoyable."

Eight students checked that the "PLATO presentation seems most effective" for the material they saw when compared to other possible presentations. The other six responses seemed to indicate that the students did not understand the question. One student in listing other appropriate media gave "PLATO"! The other five students failed to list any medium.

On "what did you like least about the lesson," the only comment was "not enough time." (Three responses.)

On "what did you like most about the lesson," the responses were tabulated as follows:

| | |
|---|---|
| Fun | 3 |
| Helps understand topic | 3 |
| Interesting | 2 |
| Positive feedback | 1 |
| Working at own pace | 1 |
| Diagnostic feedback | 2 |

Here are some of their comments:

"It was so entertaining and very exciting. It gives you the feeling of wanting to learn."

"It helped me sort of to comprehend more than what I knew about fractions."

"I liked all of it."

"I think it is the most interest (sic) subject that I evey (sic) come across."

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"It makes learning fun."

"What I liked most is when you have something wrong it tells you."

V. Recommendations

The results of this practicum indicate that the computer-based instruction lesson on "Divisibility Rules" needs to be given to a group of GED students who have used PLATO at least one time prior to the experiment. Although there would probably be more difficulty determining whether the students were evaluating the medium rather than the message, from a practical perspective they would not be encumbered by difficulties in operating the machine. Even though such difficulties were not specifically reported by the students in their evaluation of the lesson, this writer observed these difficulties and how the students were handicapped in trying to take a test on which each problem was timed. It is significant that although the goal of having at least 80% of the students achieve mastery was not reached, this did not affect the very positive attitudes these students had for their experience. It is expected that the next experiment (February 1975) will substantiate both hypotheses concerning mastery learning; the results will be forwarded to Nova University.

If the results of the next test-run prove successful, the systematic lesson design used for this practicum will be recommended as a basic lesson format for other computer-based instruction authors.

This practicum has demonstrated the importance of thorough developmental testing in revising and refining an individualized learning module. It will be recommended that instructors at Kennedy-King College who are reviewing lessons designed for their students use a lesson evaluation checklist such as the one used in this practicum; their responses will help determine and correct lesson mistakes and inadequacies. Also, the lesson on "Divisibility Rules" should have been tested by a group of GED students before the experiment was conducted; unfortunately, time and other practical concerns precluded this.

An unanticipated question brought out by this practicum involves the pattern by which disadvantaged students learn best. Would these students have shown better achievement scores had they been directed throughout the instruction without being able to select topics? Some of the students in the experiment were observed skipping various topics or not completing them in the sequence suggested. Even so, a democratic society presupposes that people <u>learn</u> to make intelligent choices and decisions. Perhaps we need to spend more

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time working with objectives such as this one on teaching our students how to make intelligent choices. This is at least as important as content skills such as learning to apply divisibility rules.

It will also be recommended that an experiment be conducted to compare the achievement results of students who use a PLATO lesson which applies mastery learning techniques (perhaps this lesson on "Divisibility Rules") with the results demonstrated by students who receive conventional instruction. This will probably be this writer's practicum for the Nova University module on Applied Educational Research and Evaluation.

APPENDICES

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Appendix A

Selected Characteristics of Kennedy-King College Students 1973

Age

| | % of students | | % of students |
|---|---|---|---|
| 17 | 3.5% | 22-25 | 21.1% |
| 18 | 10.3 | 26-30 | 16.2 |
| 19 | 10.6 | 31-40 | 17.1 |
| 20 | 8.0 | Over 40 | 7.0 |

Sex

| | % of students | | % of students |
|---|---|---|---|
| Male | 45.8% | Female | 54.2% |

Legal Residence

| | % of students |
|---|---|
| Chicago | 99.4% |
| Outside Illinois | .4 |
| Inside Illinois, outside Chicago | .2 |

Distance from College

| From residence to college | % of students |
|---|---|
| Less than one mile | 9.9% |
| 1-2 miles | 18.0 |
| 2-3 miles | 17.9 |
| 3-5 miles | 21.0 |
| 5-7 miles | 14.1 |
| 7-10 miles | 9.6 |
| 10 miles or more | 9.5 |

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Appendix A

Selected Characteristics of Kennedy-King College Students 1973

Ethnic Background

| | % of students |
|---|---|
| Black | 97.5% |
| American Indian | .4 |
| Oriental American | .1 |
| Mexican American | .3 |
| Spanish surname | .2 |
| White | .7 |
| Other | .9 |

Rank in High School Graduating Class

| | Percentile |
|---|---|
| Top quarter | 18.5% |
| 2nd quarter | 37.7 |
| 3rd quarter | 24.6 |
| Lowest quarter | 2.8 |
| GED Certificate | 8.1 |
| Non-graduates | 8.3 |

Areas of Educational Interest

| | % of students |
|---|---|
| Business | 28.2 |
| Creative, cultural & performing arts | 6.3 |
| Engineering & industrial arts | 11.0 |
| General studies | 4.0 |
| Health | 14.0 |
| Liberal arts | 9.2 |
| Public & human services | 18.2 |
| Undecided | 9.2 |

Appendix A

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Selected Characteristics of Kennedy-King College Students 1973

Future Plans

| | % of students |
|---|---|
| Transfer to four-year college | 67.4% |
| Employment | 19.1 |
| Neither or does not apply | 13.5 |

Annual Family Income

| | % of students |
|---|---|
| Under $3,000 per year | 16.9% |
| $3,000 to 5,999 | 21.2 |
| $6,000 to 7,499 | 10.8 |
| $7,500 to 8,999 | 10.0 |
| $9,000 to 11,999 | 12.8 |
| $12,000 or over | 7.0 |
| Do not know or confidential | 21.3 |

Appendix B

STUDENTS PLATO EVALUATION

Date _____ College _____

Course Title _____ Course Number _____

Instructor _____

Please answer the following questions about your experiences with and your opinions of the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO.

1. How many hours have you used PLATO during class time? _____
2. How many hours have you used PLATO outside of class? _____
3. After your first session, how were you helped while you used PLATO? Check the appropriate box in each row.

| | Often | Sometimes | Never |
|---|---|---|---|
| I received help from my instructor | | | |
| I received help from other students | | | |
| I received help from other people | | | |
| I worked on my own without help | | | |

4. Indicate the feelings you have had while using PLATO. Check the appropriate box in each row.

| | Often | Sometimes | Never |
|---|---|---|---|
| Fun | | | |
| Frustrated | | | |
| Challenged | | | |
| Annoyed | | | |
| Confused | | | |
| Proud of myself | | | |
| Bored | | | |
| Relaxed | | | |

5. Indicate your feelings towards the PLATO lessons you have used. Check the appropriate box in each row.

| | Most | Some | None |
|---|---|---|---|
| The lessons were easy to get through | | | |
| I learned what the lesson tried to teach | | | |

6. How often has PLATO worked when you have attempted to use it?

__Always(100%) __Often(75%) __Half the time(50%) __Seldom(25%) __Never(0%)

7. During how many sessions have the mechanical interruptions made you want to stop using PLATO?

__Always(100%) __Often(75%) __Half the time(50%) __Seldom(25%) __Never(0%)

8. Has typing your answers on PLATO bothered you?

__Not at all __Very little __Somewhat __Quite a lot __Always

9. Would you encourage your friends to take a course that uses PLATO?

__Yes __No __Uncertain

10. What have you liked least about PLATO? (You may use the other side.)

11. What have you liked best about PLATO? (You may use the other side.)

Appendix C

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Selected Data from the Students PLATO Evaluation, May 1974

| Item no. | Items and Alternatives | Freq. | Percent |
|---|---|---|---|
| 4* | Indicate the feelings you have had while using PLATO | | |
| | Fun | | |
| | Often | 94 | 50.54%** |
| | Sometimes | 70 | 37.63 |
| | Never | 8 | 5.38 |
| | No response | 14 | 7.53 |
| | Frustrated | | |
| | Often | 15 | 8.06 |
| | Sometimes | 102 | 54.84 |
| | Never | 47 | 25.27 |
| | No response | 22 | 11.83 |
| | Challenged | | |
| | Often | 110 | 59.14 |
| | Sometimes | 55 | 29.57 |
| | Never | 8 | 4.30 |
| | No response | 13 | 6.99 |
| | Annoyed | | |
| | Often | 7 | 3.76 |
| | Sometimes | 67 | 36.02 |
| | Never | 89 | 47.85 |
| | No response | 23 | 12.37 |
| | Confused | | |
| | Often | 10 | 5.38 |
| | Sometimes | 115 | 61.83 |
| | Never | 42 | 22.58 |
| | No response | 19 | 10.22 |
| | Proud of myself | | |
| | Often | 72 | 38.71 |
| | Sometimes | 91 | 48.92 |
| | Never | 7 | 3.76 |
| | No response | 16 | 8.60 |
| | Bored | | |
| | Often | 4 | 2.15 |
| | Sometimes | 31 | 16.67 |
| | Never | 123 | 66.13 |
| | No response | 28 | 15.05 |

*Item number on questionnaire

**These percentages are based on the total number of students who completed the questionnaire (186) rather than on the number of students who responded to the question.

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Appendix C

Selected Data from the Students PLATO Evaluation, May 1974

| Item no. | Items and Alternatives | Freq. | Percent |
|---|---|---|---|
| 4 (cont.) | Indicate the feelings you have had while using PLATO | | |
| | Relaxed | | |
| | Often | 81 | 43.55 |
| | Sometimes | 77 | 41.40 |
| | Never | 15 | 8.06 |
| | No response | 13 | 6.99 |
| 5 | The PLATO lessons were easy to get through | | |
| | Most | 64 | 34.41 |
| | Some | 104 | 55.91 |
| | None | 8 | 4.30 |
| | No response | 10 | 5.38 |
| | I learned what the PLATO lessons tried to teach | | |
| | Most | 106 | 56.99 |
| | Some | 71 | 38.17 |
| | None | 0 | 0 |
| | No response | 9 | 4.84 |
| 6 | How often has PLATO worked when you have attempted to use it? | | |
| | Always (100%) | 66 | 35.48 |
| | Often (75%) | 90 | 48.39 |
| | Half the time (50%) | 22 | 11.83 |
| | Seldom (25%) | 5 | 2.69 |
| | Never (0%) | 1 | 0.54 |
| | No response | 2 | 1.08 |
| 7 | Have mechanical interruptions made you want to stop using PLATO? | | |
| | Always (100%) | 1 | 0.54 |
| | Often (75%) | 16 | 8.60 |
| | Half the time (50%) | 25 | 13.44 |
| | Seldom (25%) | 65 | 34.95 |
| | Never (0%) | 76 | 40.86 |
| | No response | 3 | 1.61 |

Appendix C

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Selected Data from the Students PLATO Evaluation, May 1974

| Item no. | Items and Alternatives | Freq. | Percent |
|---|---|---|---|
| 8 | Has typing your answers bothered you? | | |
| | Not at all | 119 | 63.99 |
| | Very little | 43 | 23.12 |
| | Somewhat | 20 | 10.75 |
| | Quite a lot | 3 | 1.61 |
| | Always | 0 | 0 |
| | No response | 1 | 0.54 |
| 9 | Would you encourage friends to take a course that uses PLATO? | | |
| | Yes | 166 | 89.25 |
| | No | 5 | 2.69 |
| | Uncertain | 15 | 8.06 |
| | No response | 0 | 0 |
| 10 | What have you liked least about PLATO? | | |
| | Nothing/I liked it | 42 | 22.58 |
| | Not enough time or opportunity to use it | 16 | 8.60 |
| | Not enough terminals | 4 | 2.15 |
| | Mechanical difficulties, interruptions | 15 | 8.06 |
| | Pushing HELP does not always get help | 12 | 6.45 |
| | Waiting | 1 | 0.54 |
| | Terminology: having to use exact wording | 2 | 1.08 |
| | Not knowing how to correct an error | 5 | 2.69 |
| | Question raised, can't get back to sect | 4 | 2.15 |
| | Not enough courses | 1 | 0.54 |
| | Lack of information on some topics | 4 | 2.15 |
| | Coloring hurts eyes | 5 | 2.69 |
| | Having to type | 2 | 1.08 |
| | Newness | 2 | 1.08 |
| | Boring | 1 | 0.54 |
| | Do not know yet | 1 | 0.54 |
| | Other | 16 | 8.60 |
| | PLATO programmed to admit mistakes | 1 | 0.54 |
| | No response | 52 | 27.96 |

Appendix C

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Selected Data from the Students PLATO Evaluation, May 1974

| Item no. | Items and Alternatives | Freq. | Percent |
|---|---|---|---|
| 11 | What have you liked most about PLATO? | | |
| | Gratuitous comment | 17 | 9.14% |
| | Learn more/faster; better understanding | 23 | 12.37 |
| | Newness; a change | 4 | 2.15 |
| | A challenge | 15 | 8.06 |
| | Helpful in explaining, reviewing | 13 | 6.99 |
| | Work at own speed; help self | 20 | 10.75 |
| | Rapid | 4 | 2.15 |
| | Repititious; patient | 5 | 2.69 |
| | Available feedback; types of responses | 9 | 4.84 |
| | Orderly; step by step | 4 | 2.15 |
| | Pictures and illustrations | 1 | 0.54 |
| | Typing, instead of writing | 2 | 1.08 |
| | Everything | 5 | 2.69 |
| | (Naming a particular lesson) | 3 | 1.61 |
| | Nothing (complaint) | 1 | 0.54 |
| | Other | 18 | 9.68 |
| | No response | 42 | 22.58 |

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Appendix D

Sample Frames from the PLATO Lesson on "Divisibility Rules"

(from the introduction/rationale)

---

INTRODUCTION

When you complete this lesson on "Divisibility Rules, you will be able to recognize at a glance whether or not a number is divisible by the most frequent divisors: 2, 3, 5 and 10.

The term DIVISIBLE means that a number can be divided without leaving a remainder. For example, 8 is divisible by 2 since $8 \div 2 = 4$; on the other hand, 9 is not divisible by 2 since $9 \div 2 = 4$ with a remainder of 1.

If you are interested, you can learn the divisibilty rules for 4, 6 and 9; and you also can learn how to determine the greatest common divisor of the numerator and the denominator of any fraction.

When you complete this lesson you will be able to reduce most fractions to their lowest terms with more confidence and less guesswork.

Decide what you want to do:

Press 1.....to select a topic to study.

Press 2.....to take a short quiz to see if you need to study this lesson (Do this only if your instructor wants you to).

---

Appendix D: Sample Frames

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(from instruction given in one of the topics)

---

A number is divisible by 3 if the sum of its digits can be divided evenly by 3. For example, the sum of the digits in 231 is 6 (2 + 3 + 1 = 6); since 3 divides 6 evenly (no remainder), the number 231 is divisible by 3.

---

What is the sum of the digits in the number 834?

> 15 ok

---

Can this number (15) be evenly divided by 3?

> yes ok

So the original number (834) is divisible by 3.

---

Type the letter by the number which is divisible by 3.

a. 731
b. 259
c. 941
d. 714
e. 202

> a

The digits in the number you chose do not add up to a number that 3 can evenly divide, so your number is not divisible by 3.

---

> d

PLATO applauds you, Karen.

---

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Appendix D: Sample Frames

(from a practice exercise)

---

Practice Exercise 2

The following number may or may not be divisible by 3. It may be divisible by other numbers, too, but you only need to decide if it is divisible by 3.

Type 'y' if divisible by 3.
Type 'n' if not divisible by 3.

NUMBER: 1446 (randomly generated by PLATO)

> y (student response)

PLATO agrees, Karen. (PLATO's response to student)

Number correct: 6 Number wrong: 1

Let's consider you an expert if you can get at least 6 correct. You will be given review should you miss 3.

---

(Student told when starting this frame that "you have about 15 seconds to complete each problem. Press -NEXT- when you are ready to start.")

(Had the student answered 'n' to the problem listed above, she would have received the response that the number is divisible by 3, since the sum of the digits totals a number which 3 can divide evenly.)

Appendix D: Sample Frames

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(from the posttest)

---

Practice Exercise 6 and Final Quiz

Type ALL the numbers (2, 3, 5 and 10) that will divide evenly both numbers of the fraction shown below.

Press 'n' if both numbers are not divisible by either 2, 3, 5 or 10.

ORIGINAL FRACTION: $\frac{138}{156}$ (randomly selected by PLATO from a predetermined list)

>

Sorry, your time is up. It is divisible by: 2, 3.

Number correct: 0 Number wrong: 1

Let's consider you an expert if you can get at least 10 correct. You will be given review should you miss 4.

---

(Student told when starting this frame that "you have about 25 seconds to complete each problem. Press -NEXT- when you are ready to start.")

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Appendix E: PLATO Lesson Evaluation IV

PLATO Lesson Evaluation: Checklist for Users

Lesson title or description_____
Date reviewed_____
Reviewer_____
Position (e.g., instructor)_____
Department and Institution_____

Your review of this lesson will be helpful in providing feedback on the quality of the lesson to the author for possible revision.

ANALYSIS OF LESSON CONTENT

Please elaborate on any problems you find in order that necessary changes in the lesson can be made.

1. Are there any typographical errors in the lesson?

2. Are there any subject-matter errors in the lesson?

3. Are the directions clear?

4. Are all reasonable answers to questions accepted?

5. Is it clear what the student should learn?

6. Is the reading level offered by the lesson appropriate to the level required by the students for whom it is intended?

7. Does the lesson explain or demonstrate its relevancy or usefulness?

8. Is the student compelled to be actively involved in the lesson? (Is the student compelled to respond frequently throughout the lesson, or is he primarily involved by pressing -NEXT-?)

9. Check the technique used by the lesson to help the student learn:
   __a. tutorial
   __b. drill and practice
   __c. simulations
   __d. games
   __e. other (list:_____)

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10. Check the kinds of responses required by the student:

__a. True-false or yes-no
__b. Multiple choice or matching
__c. Constructed response
__d. Multistep responses as in simulation, building on previous steps
__e. Other (specify:_____)

11. How is immediate feedback used and in general what is its quality? (e.g., is the student aware of his progress? Is positive reinforcement provided? How is the student helped when he makes an incorrect response?)

12. In your estimation, can the student complete the lesson without learning the material?

13. Is the lesson self-contained? (e.g., is an instructor's presence or additional information essential to the lesson's effectiveness?)

14. What do you think about the lesson as a whole? Is it complete, well presented and polished?

STUDENT CONVENIENCE LESSON FEATURES

1. Is there an easily accessible table of contents? (This will help the student review portions of the lesson.)

2. Are there sequencing problems that would prevent a student from continuing or completing the lesson? If so, where?

3. Estimate the time it would take for a student to complete the lesson.

STUDENT DATA

1. Does the lesson have a pretest and a posttest?

2. If there is a posttest, does it assess whether or not the student has mastered what the lesson was supposed to teach him?

3. Is the information on the student's performance easily accessible by the instructor?

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CRITICAL INFORMATION:

1. Do you believe this lesson will be motivating to the student it is designed to serve?

2. Check how the lesson might be appropriate for a course you teach?

__a. It serves as a portion of what I teach
__b. It is appropriate for remediation
__c. It is appropriate for enrichment
__d. Other appropriate use:_____
__e. It is inappropriate because_____.

3. On the whole, how would you rate the lesson:

__a. Excellent
__b. Good
__c. Fair
__d. Poor

4. Do you plan to use this lesson? Check one:

__a. Yes, without reservation
__b. Yes, portions of the lesson
__c. Yes, if the lesson is revised
__d. No,because_____

5. Would you recommend this lesson to fellow instructors or to students?

6. Is there a teachers guide available for this lesson? Check all that apply:

__a. Yes
__b. There is some information for the instructor provided on PLATO (-TERM- "instruct" may provide this)
__c. No, and a guide would be useful
__d. No, and a guide would not be necessary

Appendix F

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PLATO Evaluation

Your first impressions of PLATO (though based on brief experience) can provide valuable information for improvement of teaching material and the PLATO system. The time you spend in answering the following questions will be greatly appreciated.

1. Did you enjoy PLATO? (check one)

___one of the most enjoyable educational experiences I have had

___quite enjoyable

___neutral (so what?)

___a rather negative experience

___one of the least enjoyable educational experiences I have had

2. Do you think the material you saw could have been taught as rapidly or completely if it had been presented by a more usual educational medium (such as lecture or textbook)?

___No, PLATO presentation seems most effective

___Yes, presentation would have been equally effective by (list other media)_____

___Yes, presentation would have been more effective by (list other media)_____

3. What did you like least about the lesson?

4. What did you like most about the lesson?

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FOOTNOTES

[1]Percival M. Symonds, What Education Has to Learn from Psychology, 3rd. ed. (New York: Bureau of Publications, Teachers College, Columbia University, 1964), p. 1.

[2]James H. Block, "Introduction to Mastery Learning: Theory and Practice," Chapt. 1, Mastery Learning: Theory and Practice, James H. Block, ed. (New York: Holt, Rinehart and Winston, Inc., 1971), pp. 2-3.

[3]The term "mastery learning" was coined by Benjamin S. Bloom in 1968.

[4]PLATO stands for Programmed Logic for Automatic Teaching Operation and is the computer-based instructional system developed by the Computer-based Education Research Laboratory (CERL) at the University of Illinois in Urbana.

[5]James H. Block, Mastery Learning, pp. 3-4.

[6]Susan Meyer Markle, "The Basic Programming Principles," Chapt. 1, Good Frames and Bad, 2nd. ed. (New York: John Wiley & Sons, Inc., 1969), pp. 2-25.

[7]John B. Carroll, "A Model of School Learning," Teachers College Record, vol. 64, 1963, pp. 723-733; quoted in James H. Block's Mastery Learning: Theory and Practice, p. 5.

[8]James H. Block, Mastery Learning, pp. 5-6.

[9]Ibid., pp. 6-7.

[10]Ibid., pp. 7-8.

[11]Ibid., p. 11.

[12]James H. Block, "Teachers, Teaching, and Mastery Learning, Today's Education, Nov.-Dec. 1973, pp. 31-33.

[13]Benjamin S. Bloom, "Mastery Learning," Chapt. 4, Mastery Learning: Theory and Practice, James H. Block, ed. (New York: Holt, Rinehart and Winston, Inc., 1971), pp. 47-62.

[14]PLATO has been developed under the direction of Dr. Donald Bitzer of CERL at the University of Illinois in Urbana.

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[15](Errol Magidson), "Description of PLATO," PLATO Project--An Overview, unpublished manuscript, April 1972.

[16]Ernest R. Hilgard and Gordon H. Bower, "Learning and the Technolo y of Instruction," Chapt. 16, Theories of Learning, 3rd ed. (New York: Appleton-Century-Crofts, 1966), pp. 541-584.

[17]Ibid., p. 563.

[18]"Student Attitudes toward PLATO, Survey Results," CERL Evaluation Report (Urbana: University of Illinois, January 28, 1972).

[19]"Selected Characteristics of CCC Students, (Chicago: City Colleges of Chicago, fall 1973).

[20]Carolyn J. Smith, "The PLATO IV Project, Learning Theory and Inner-city Community College Instruction," unpublished manuscript presented to University of Chicago, winter quarter 1973, p. 15.

[21](Errol Magidson and William Mahler), Students PLATO Evaluation, questionnaire, June 1974, p. 1.

[22]Tabulations of the data were made by the PLATO Coordinator and the Educational Testing Service.

[23](Barton R. Herrscher), Implementing Self-Paced, Self-Directed Learning, unpublished manuscript, c. 1972, pp. 1 - 27.

[24]Ibid., p. 10.

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BIBLIOGRAPHY

Alpert, D. and Bitzer, D. L., "Advances in Computer-based Education," Science, vol. 167, March 20, 1970, pp. 1582-1590.

Anastasio, Ernest and Morgan, Judith S., Factors Inhibiting the Use of Computers in Instruction (Washington, D.C.: Educom, 1972).

Block, James H., ed., "Introduction to Mastery Learning: Theory and Practice," Chapter 1, Mastery Learning: Theory and Practice (New York: Holt, Rinehart and Winston, 1971).

Block, James H., "Teachers, Teaching, and Mastery Learning," Today's Education, Nov.-Dec. 1973, pp. 30-36.

Bloom, Benjamin S., "Learning for Mastery," UCLA Evaluation Comment, May 1968, pp. 1-12.

Bloom, Benjamin S., "Mastery Learning," Chapter 4, in Mastery Learning: Theory and Practice, James H. Block, ed.

Carroll, John B., "A Model of School Learning," Teachers College Record, vol. 64, 1963, pp. 723-733, quoted in James H. Block's Mastery Learning: Theory and Practice.

(Herrscher, Barton R.), Implementing Self-Paced, Self-Directed Learning, unpublished manuscript, c. 1972, 27 pages.

Hilgard, Ernest R. and Bower, Gordon H., "Learning and the Technology of Instruction," Chapter 16, Theories of Learning, 3rd ed. (New York: Appleton-Century-Crofts, 1966), pp. 541-584.

(Magidson, Errol), "Description of PLATO," PLATO Project--an Overview, unpublished manuscript by Rattan Bhatia, Barbara Gaither, Benjamin Lathan, Thomas Lenehen, Mitsuru Yamada and Errol Magidson, April 1972.

(Magidson, Errol and Mahler, William), Students PLATO Evaluation, questionnaire, June 1974, 1 page.

PLATO, (Urbana: University of Illinois, CERL), pamphlet, c. 1973.

"Student Attitudes toward PLATO, Survey Results," CERL Evaluation Report (Urbana: University of Illinois, CERL), January 28, 1972.

Symonds, Percival M., What Education Has to Learn from Psychology, 3rd. ed. (New York: Bureau of Publications Teachers College, Columbia University, 1964).